LA-UR-22-21473

Approved for public release; distribution is unlimited.

Title:	K-Modules: Capacitive Energy Modules for Pulsed Power Applications
Author(s):	Dighe, Kalpak Arvind
Intended for:	F0r discussion at DisrupTech program
Issued:	2022-02-22

K-Modules: Capacitive Energy Modules for Pulsed Power Applications

Kalpak A. Dighe; J-Division; kdighe@lanl.gov; (505) 665 1701

PROBLEM

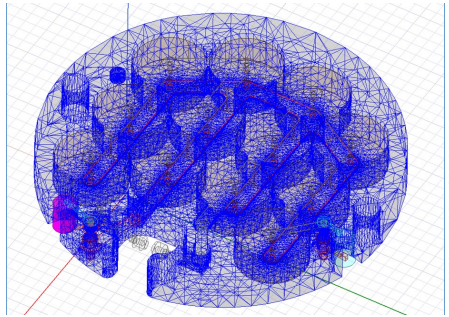
- Current design of pulsed power system in Febetrons (X-ray generating machines) has **not changed in 40 yrs.**
- Only **one supplier since 1970's** for replacement parts.

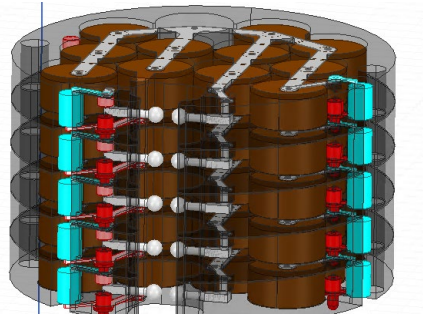
APPLICATION

- Users who have already expressed interest in the developed technology are DOE labs, DoD (US Air Force, US Army) as well as private sector companies, e.g., Northrup Grumman and Boeing.

- Developed technology retains same form factor of current modules, thus simple drop-in process 'OUT with the old, IN with the new' for the Febetrons. Customized modules with varied outputs can easily be fabricated for other applications.

- Entities using Febetrons for X-ray or electron beam applications will benefit from this technology. Alternate pulsed power applications are being investigated (e.g. accelerators).





SOLUTION

- The technology is a module containing an assembly of capacitors. The modules are meant to be daisy-chained to form a Marx bank (bank of capacitors). Discharging the bank produces a high voltage, high current pulse, that when coupled to an X-ray or electron beam tube, generates X-rays or an intense electron beam.
- **Number of modules in the stack can be varied** to meet different pulsed power applications.
- The technology **addresses the need for an alternate provider** with a new, robust design. The technology has the potential to **extend the life** of the X-ray radiography program in the country.

- K-Module has been pulsed over 400 times in the past two years in an operational unit at LANL's firing point, thereby proving its robustness and performance.

K-Modules: Capacitive Energy Modules for Pulsed Power Applications

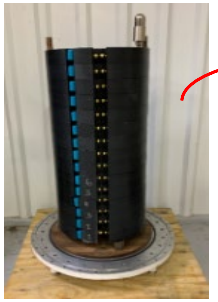
Kalpak A. Dighe; J-Division; kdighe@lanl.gov; (505) 665 1701

BENEFITS

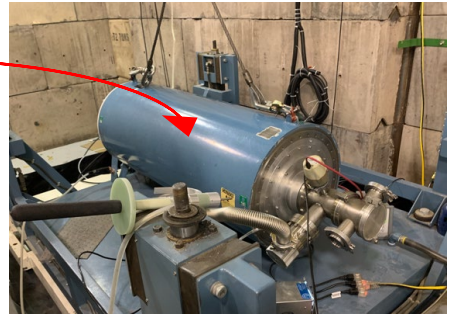
- Higher output
- Modular, thus scalable output
- Serviceable
- Reusable components

COMPETITIVE ADVANTAGE

- Provides much needed **design upgrade** - present design is **40+ years old**.
- Stores **twice the energy** and provides higher voltage, higher current and **~30 % higher X-ray dose** than the present design.
- Provides end-users with an **alternate procurement source** - there has been **only one supplier for 40+ years**.
- New modules are assembled with COTS components and **does not involve chemical processes** that are needed currently.
- Reduced manufacturing time (e.g. **5 months** to manufacture 100 K-modules **vs 14 months** to manufacture 100 of the current modules)



Stack of 15 modules undergoing testing



TECHNOLOGY STATUS AND NEXT STEP

Feb-Jun 2022

- Continue lab experiments
- Refine and finalize designs
- Investigate 'other than X-ray' applications
- Customer discovery

Jul–Nov 2022

- File non-provisional patent
- File for small business start-up
- Commercialize products

TECHNOLOGY READINESS LEVEL AND IP

- Between **TRL5** and **TRL6**. Operation of multiple modules have been demonstrated in the laboratory; performance and quantitative data have been logged.
- **LANL/TRIAD has already filed an application for a provisional patent (S167562).**